eg. a pokemon ball rolls down a 5.0m high hill. If the ball is 0.500kg, what is

a) the gravitational energy at the top of the hill
b) if the ball is moving at 5.0 m/s at the top of the hill, what is the kinetic energy and total energy of the ball?
c) if no energy is lost due to friction, what would be the speed of the ball at the bottom of the hill?
d) if the speed at the bottom of the hill is 9.0 m/s, how much energy was lost to frictional or rotational energies?

p224-230 Q5-12, CR 1.1-1.5
(we will go over CR 2.1-2.4 from the homework p 211 later in the class) p234-235 Q13-16
elastic collision - momentum and Ek conserved
http://techtv.mit.edu/videos/1491-potential-energy-to-kinetic-energy

https://www.youtube.com/watch?v=BVxEEn3w688&feature=fvw

a) Eg = mgh = 0.5x9.8x5=24.5 J
kgxN/kgxm = Nm = J
Ek = 1/2 mv^2 = 0.5x0.5x5x5=6.25 J
E_{total} = Eg+Ek = 24.5+6.25=30.75 J
c) big idea: energy is conserved, so

total energy initial = total energy final
30.75J = Ek = $1/2mv^2$
v = Sqrt(2x30.75/0.5)=11.09053650640942
v = 11m/s

d) total energy initial = total energy final
$E_{gi} + E_{ki} = E_{kf} + E_{lost}$ (Eg is zero at the bottom, that is where you set h=0)
$E_{total\ i} = 1/2mv_f^2 + E_{lost}$
30.75J = 0.5x0.5x(9^2) + Elost
Elost = 30.75-(0.5x0.5x(9^2))=10.5 J lost to frictional or rotational effects

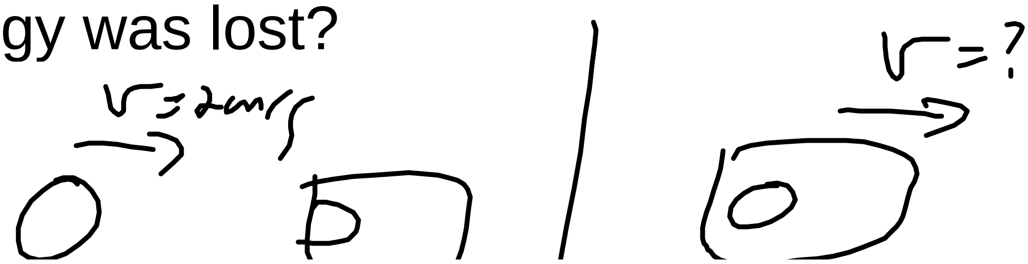
Collisions - momentum is conserved

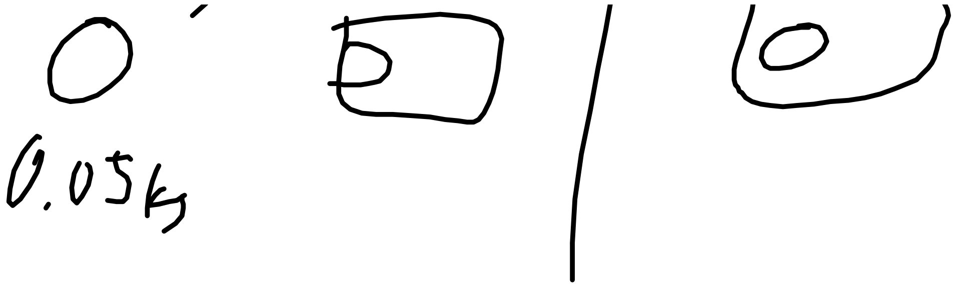
perfectly elastic collision both momentum and kinetic energy are conserved.

eg. a 0.050kg ball is moving at 2.0 m/s when it hits a 0.200kg target at rest.

a) what is the momentum and kinetic energy of the ball before the collision?
p=mv = 0.05x2=0.10 kgm/s
Ek = $1/2mv^2$ = 0.5x0.05x2x2=0.10J

b) if the ball sticks into the target and they move off together, what is their speed? How much kinetic energy was lost?





pi = pf

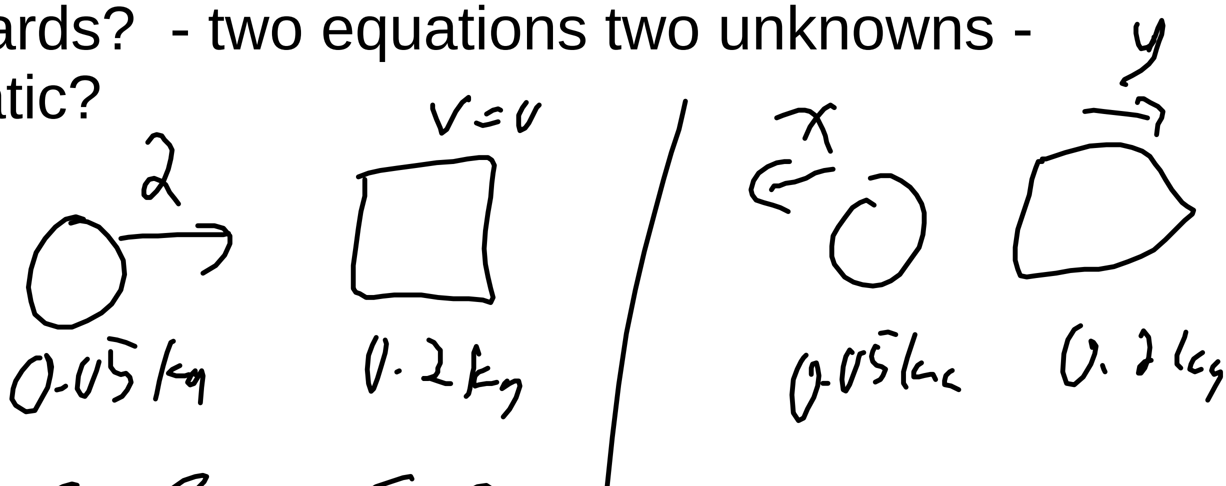
0.10kgm/s +0 = (0.05+0.2)v

v= 0.1/(0.05+0.2)=0.40m/s

E_{kf} = 0.5x0.25x0.4^2=0.02 J

Ek lost = 0.1-0.02=0.08 J most of the Ek was lost

c) bonus: if the ball bounces off with a perfectly elastic collision, what are the speeds of the two balls afterwards? - two equations two unknowns - quadratic?



$\Sigma P_i = \Sigma P_f \rightarrow 0.1 = 0.05x + 0.2y$

$2 = x + 4y$

$\Sigma E_{k_i} = \Sigma E_{k_f} \rightarrow 0.1 = \frac{1}{2}(0.05)x^2 + \frac{1}{2}0.2y^2$

$$x = (2 - 4y) \rightarrow 4 = x^2 + 4y^2$$

$$x = 2 - 4(0.8)$$
$$x = 2 - 3.2$$
$$x = -1.2$$

$$4 = (2 - 4y)^2 + 4y^2$$
$$4 = 4 - 16y + 16y^2 + 4y^2$$
$$0 = -16y + 20y^2$$
$$+16 = 20y$$

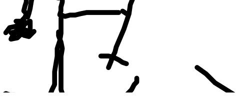
$y = 0.80\ m/s$

$x = -1.2\ m/s$

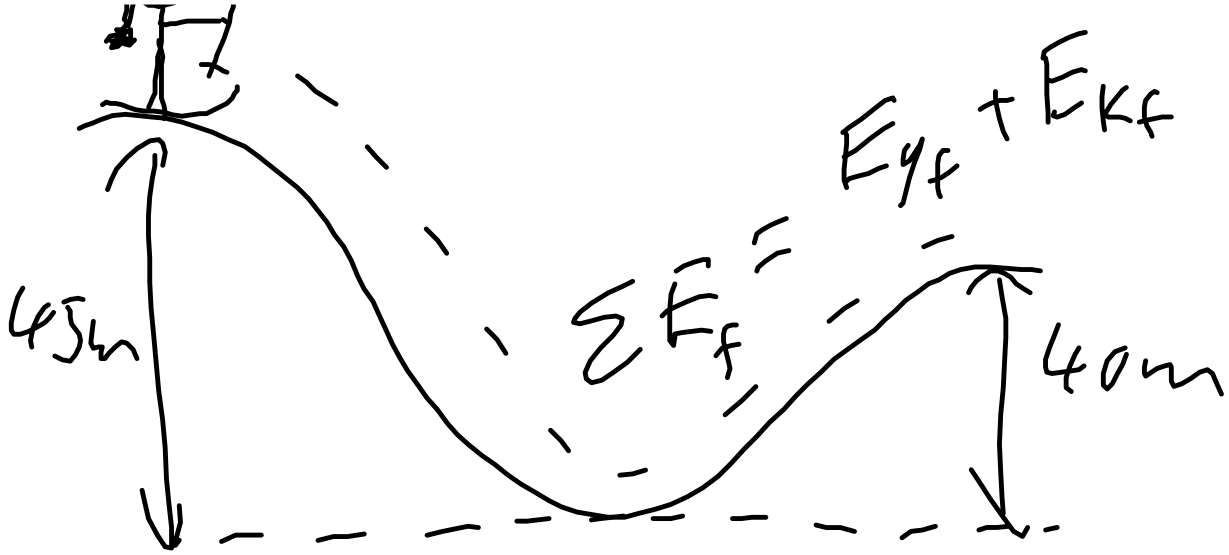
Q15

p 230
Q11

$$\Sigma E_i = E_{g1} + E_{ki}$$



$+ E_k$



$$E_{gi} + E_{ki} = E_{gf} + E_{kf}$$

a) $mgh + 0 = 0 + \frac{1}{2} m v_f^2$

v = Sqrt(9.8x45x2)=29.698484809835
30m/s at the bottom

b) mghi = 1/2 mv_f^2 + mghf

ghi-ghf = 1/2 v^2
v = Sqrt(9.8x(45-40)x2)=9.899494936611665
9.9m/s

p226
CR 1.4 and 1.5

b) W=Fd= change in energy
so if you change the mass of the block, but

use the same force over the same distance, the work and change in energy will be the same

the velocity decreases by a factor of root 2

$1/2mv^2 = 1/2(2m)(1/\sqrt{2})^2 = 1/2\ 2m\ 1/2\ v^2$

$=1/2mv^2$

1.5 the force is exerted over a constant time

Fxt = change in momentum

b) if you double the mass with the same force over the same time, the change in momentum will be the same

mv =(2m)(v/2)

so it will move with half the velocity

c) if v is half, while the m is double

$Ek = 1/2mv^2 = 1/2\ (2m)\ (1/2\ v)^2$

$= 1/2\ 2m \times 1/4\ v^2$

$= 1/2\ (1/2mv^2)$ so the Ek will be 1/2 if you double the mass but have the same impulse

the less massive block will move further in the same time (faster)

Notes:

in collisions - assume that momentum is conserved

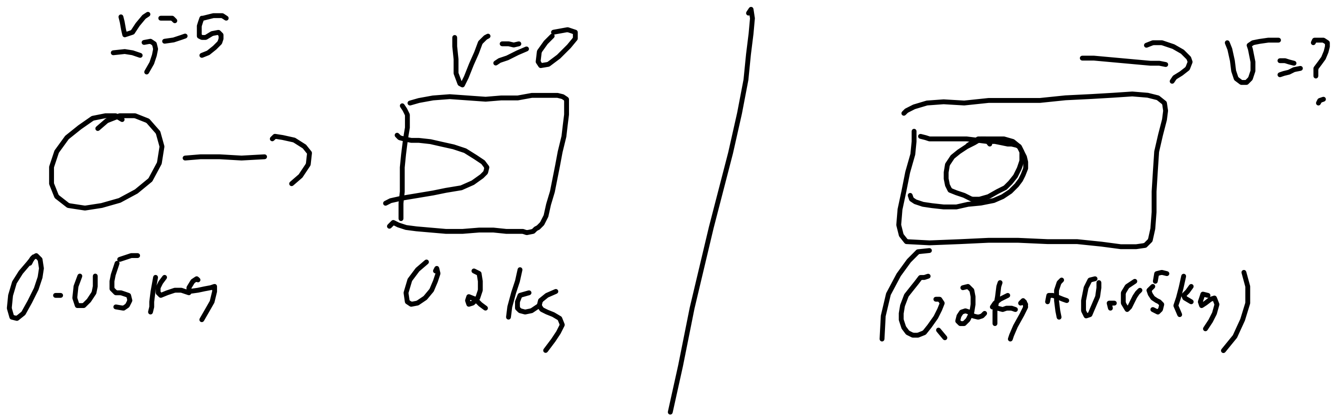
Kinetic energy and momentum are both conserved in a perfectly elastic collision

$p=mv$ $E_k=1/2\ mv^2$

eg. a 0.050kg marble is moving at 5.0m/s when it collides with a 0.200kg target at rest.

a) what is the momentum and kinetic energy of the marble before the collision?

b) if the marble sticks into the target, what is the velocity of the marble and target after the collision? How much kinetic energy was lost?



a) bonus: if it was perfectly elastic, what would be the velocities of the marble (x) and target (y) after the collision? - 2 equations with 2 unknowns unclowns?

a) $P=mv$

$P = 0.050 \times 5.0 = 0.25\ kgm/s$

$E_k = \frac{1}{2}(0.05)(5)^2 =$ ~~0.625~~

$0.625\ J$

b) $p_i = p_f$

$0.25\ kgm/s = (0.05 + 0.2)v$

v= 0.25/(0.05+0.2)=1.0m/s

Ek lost = Eki-Ekf = 0.625-(0.5x0.25x1^2)= 0.50 J

Where did the energy go?

heat and sound - deformation?

c) bonus:

momentum:

0.25 = 0.05x + 0.2y   x= 0.25/0.05=5.0

0.2/0.05=4.0

x = 5-4y

kinetic energy

$1/2mv^2$ = 0.625=1/2 $0.05x^2$ + 1/2 $0.2y^2$

0.625x2/0.05=25

0.2/0.05=4.0

$25 = x^2 + 4y^2$

$25 = (5-4y)^2+4y^2$

$25 = 25 -40y + 16y^2 +4y^2$

$0 = -40y +20y^2$

$y = 2.0$ m/s $x = (5-4y) = (5-4x2)=-3.0$m/s

p234-235 Q13-16